BEACON Newsletter - August 2024

Brief Insights on 3DEXPERIENCE Works Simulation

1. **What is 3DEXPERIENCE Works Simulation and what are the different types of Physics which we can Simulate using it?**

3DEXPERIENCE is a cloud-based platform solution provided by Dassault Systemes'. It acts as a Collaborative Environment where Innovation is enabled through Integration of the entire Design Process, right from Concept Generation, Modeling, Validation and Product Lifecycle Management.

3DEXPERIENCE Works Simulation takes care of the Validation part of our Design. It is built on the concept of MODSIM (An abbreviation for MODeling and SIMulation). MODSIM unites Modeling and Simulation tasks of the Design Process, to break barriers between both. It focuses on a Simulation driven Design approach and prioritizes on taking Design Decisions based on Simulation Results. To enable this concept of MODSIM a software tool must unify the modelling and simulation tasks and allow them to be done on a single platform.

3DEXPERIENCE Works Simulation capitalizes on this concept of MODSIM, thereby enabling a CAD Modeler and a CAE Engineer to work on a single collaborative platform. This helps an organization to reduce the overall design time of product, minimize reliance on physical prototyping, minimize cost as well as to avoid late-stage failures.

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The different types of Physics which can be Simulated on the 3DEXPERIENCE Platform are:

➢ **Structural Analysis**: This helps in conducting a stress analysis of the product under loading conditions like Static, Dynamic, Fatigue and Thermal. The Structural and Durability Roles on the 3DEXPERIENCE Platform allow us to test a product under as realistic as possible Loading Conditions. (A Role addresses a specific Functionality on the 3DEXPERIENCE Platform)

➢ **CFD Analysis**: Computational Fluid Dynamics Simulations can be done on the 3DEXPERIENCE Platform for simulating Fluid flow and Heat transfer effects. The Fluid Dynamics Engineer Role on the platform is developed for this purpose to conduct CFD Simulations on Engineering Products

➢ **Injection Molding Simulation:** Plastic Products manufactured using Injection Molding can be analyzed prior to manufacturing, for manufacturability and defects. This can be done using the Plastic Injection Engineer Role on the 3DEXPERIENCE Platform.

➢ **Electromagnetic Simulation:** Analyzing the Electromagnetic Performance of Equipment which work on the principles of Electromagnetics, is crucial for assuring proper functioning of the product. Electromagnetics Engineer Role on the 3DEXPERIENCE Platform is developed for conducting Electromagnetic Simulations.

2. **What are the Structural roles on the 3DEXPERIENCE Platform and their capabilities?**

Structural Roles on the platform are developed for analyzing the load bearing capacity of a product. These roles make use of the Abaqus Solver, which is the leading solver in the engineering industry for structural simulations.

There are 4 different roles available on the platform for Structural requirements,

➢ Structural Designer
➢ Structural Engineer
➢ Structural Performance Engineer
➢ Structural Mechanics Engineer

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These 4 roles are arranged in increasing capabilities of physics which they can address, when it comes to Structural requirements.

The Following types of problems can be solved using the structural roles on the 3DEXPERIENCE platform,

- ➢ Linear Static and Dynamic Analysis
- ➢ Non-linear Static and Dynamic Analysis
- ➢ Thermal Analysis
- ➢ Thermo-structural Analysis (Sequentially and Fully Coupled)
- ➢ Modal Analysis
- ➢ Frequency-domain Harmonics and Response-Spectrum study

The Abaqus Solver has both the Implicit and Explicit Time Integration Techniques to handle Transient Simulations, which can be Quasi-static to even Impact and Crashworthiness analysis.
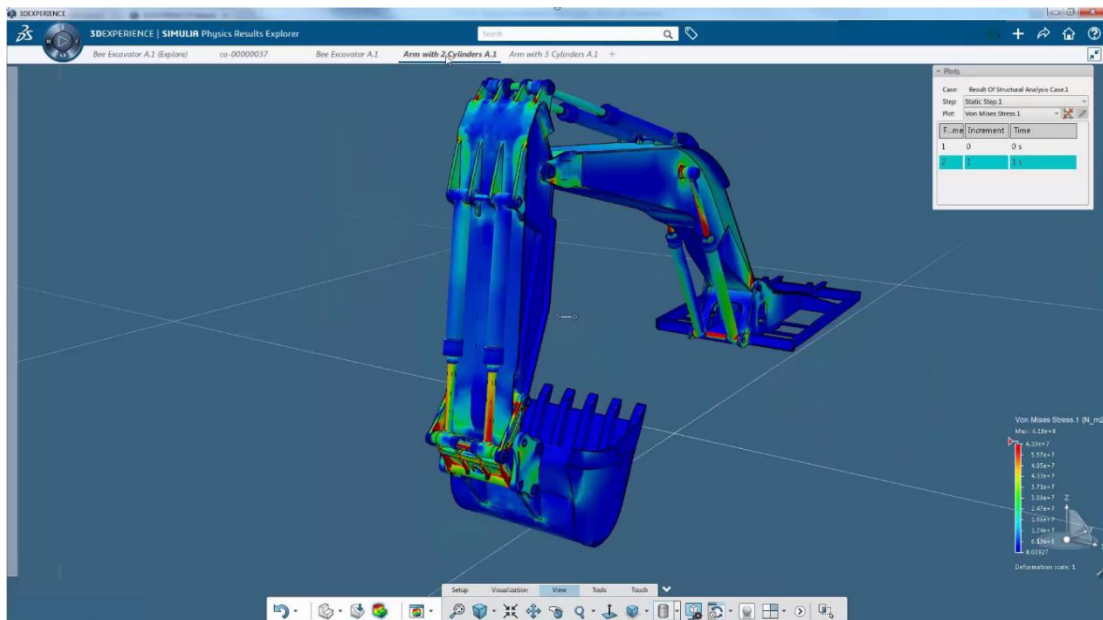
Materials: Different Class of Engineering Materials can be Simulated on the platform like Metallic Alloys, Elastomers, Non-metals, and Plastics. There are various Mathematical Models to simulate the behavior of these materials not just in the elastic but also in the Plastic deformation regime. Models to simulate the damage behavior of these materials are also available.

Mesh: The Platform is connected to the SOLIDWORKS CAD interface through a connector, by which SOLIDWORKS CAD Files can be uploaded on the platform. The Mesh Generator on the platform can then be used to mesh the CAD file, using a large variety of elements available in the library. Automated FEM Feature is also available to automate the meshing process based on a Rule-based Meshing Technique.

## 3. How does the 3DEXPERIENCE Platform Address CFD requirements for Engineering Applications?

Computational Fluid Dynamics Simulations are carried out using the Fluid Dynamics Engineer Role on the 3DEXPERIENCE Platform. Fluid Dynamics Engineer makes use of a RANS (Reynolds-Averaged Navier Stokes) based solver to solve problems involving Fluid flow and Heat transfer.

Geometry and Mesh: CFD Simulations can be carried out on native SOLIDWORKS CAD Geometry. The SOLIDWORKS File once uploaded on the platform, and opened in the CFD application, can directly be used to define the Boundary Conditions and Mesh. Using the Automatic Fluid Volume Extraction tool, we can directly define the Fluid Volume in the Computational Domain, without manually extracting surfaces to build the fluid volume.
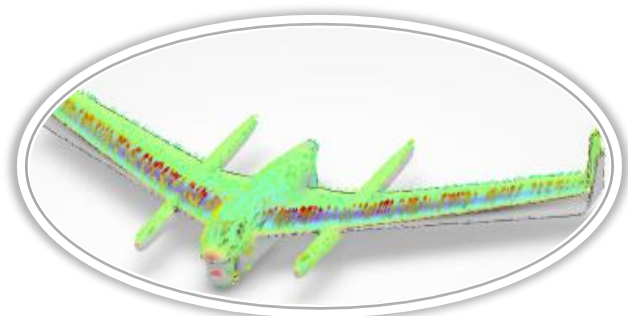
A Body-fitted Meshing Methodology is adopted by the application. This gives the user much more flexibility in terms of creating the mesh, to capture the near-wall flow parameters accurately.
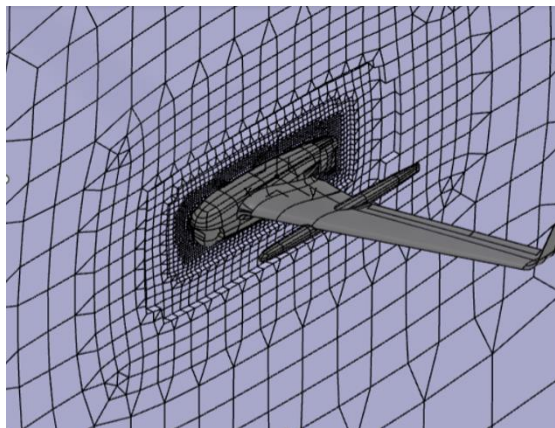
Body Fitted Mesh
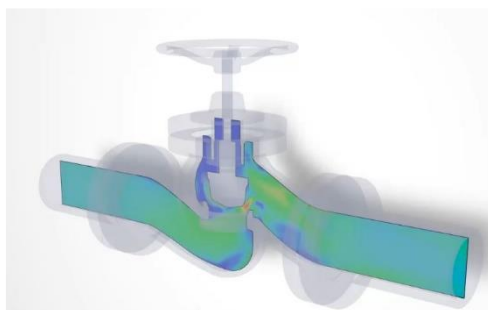
Internal Flow Analysis of a Valve


External Flow Analysis over a Drone

Solver Capabilities: The Fluid Dynamics Engineer solver makes use of Advanced Turbulence Models like Realizable k-ε, SST k-ω and Spalart-Allmaras to accurately capture the eddies in the fluid flow. It can simulate the following flow scenarios,

- Internal and External Flows
- Incompressible and Compressible Flows
- Multiphase Flow
- Flows requiring Rigid Body Motion
- Flows requiring Moving Mesh
- Newtonian and Non-Newtonian Flows
- Supersonic Flow
- Conjugate Heat Transfer Phenomena

4. **What are the capabilities of the Plastic Injection Engineer Role on the 3DEXPERIENCE Platform?**

The Plastic Injection Engineer Role is used to simulate the flow of plastic material inside the Mold Cavity during the Injection Molding Process. All the stages of the Injection Molding process can be simulated, i.e. the fill, pack, and the cool stage; hence we can identify defects that will occur in the component at all stages.

This helps in evaluating the manufacturability of the component as well as checking for defects like sink marks, weld lines, short shot, air traps etc.

Access extensive simulation results including fill pattern
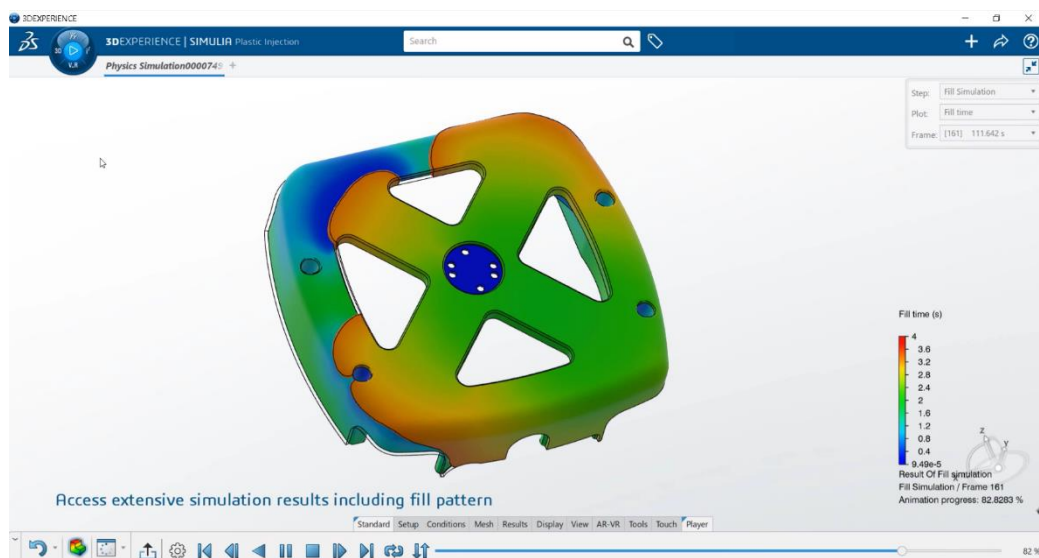
Various parameters related to Injection Molding can also be found out like finding the fill time, cool time, clamp tonnage and injection location. It also contains a complete database of Thermoplastic materials with their properties.

The Plastic Injection Role can also be used by Mold Makers to evaluate the mold before manufacturing. It can be used to conduct warpage analysis, mold cooling analysis as well as Multi-cavity Mold Analysis.

5. **How can we evaluate the Electromagnetic Performance of a Product on the 3DEXPERIENCE Platform?**

On the 3DEXPERIENCE Platform we can test the electromagnetic phenomena of a product using the Electromagnetics Engineer role. It makes use of the CST Studio Suite Solver which is the leading solver in the industry when it comes to Electromagnetic Simulations.

We can evaluate products which operate on a low frequency range like Electric Motors, Transformers, Generators etc. as well as products which operate on a high frequency range like Radars, Microwave components, IC Packages, Printed Circuit Boards etc.
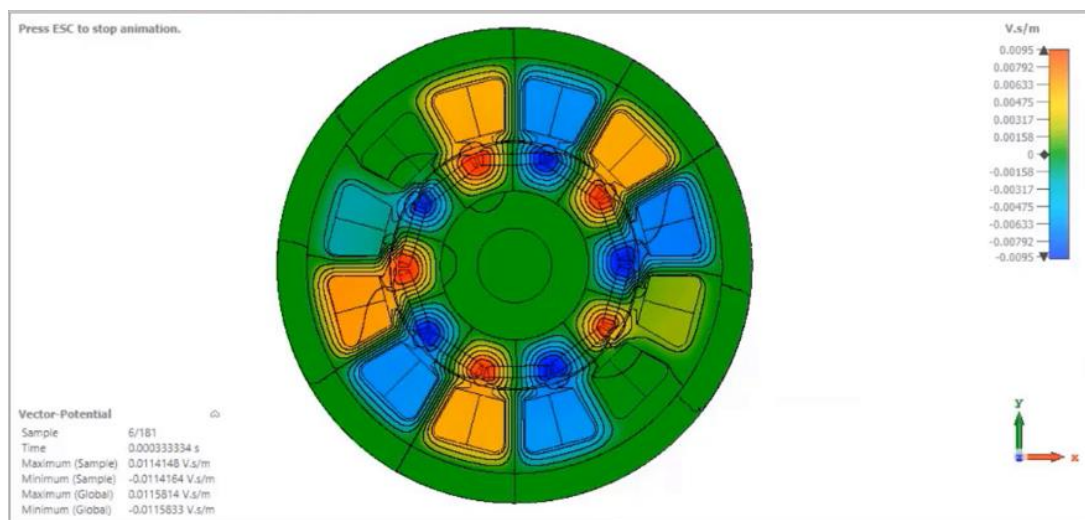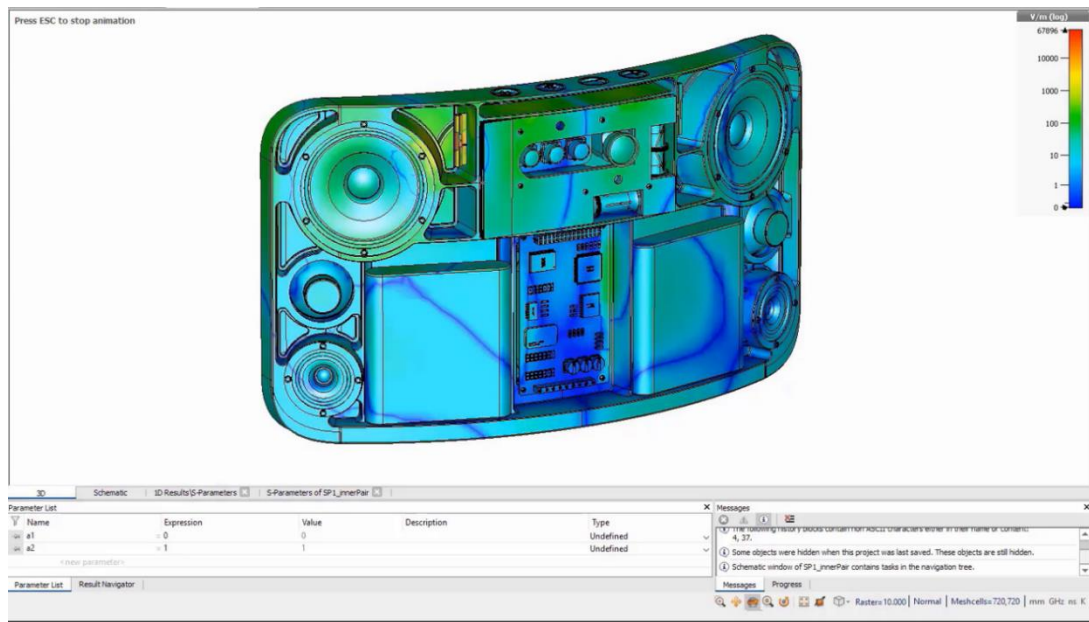
Using the Electromagnetic Engineer Role, we can address various challenges faced in the Industry like Antenna Design and placement, Circuit level Simulations, PCB Analysis, Thermal Management and EMI/EMC Simulations.

6. **Does the 3DEXPERIENCE Platform support Fluid-Structure Interaction (FSI) Analysis?**

Yes, the 3DEXPERIENCE platform supports Fluid Structure Interaction Analysis. The solvers of the Structural Role and the Fluid Dynamics Engineer role can be coupled. This helps in transferring the fluid pressure and temperature contours obtained by the CFD Analysis, to the Structural Role interface, to perform an FSI Analysis.

By using this capability, we can conduct simulations like Tank Sloshing Analysis, wind effect on the structure of a wind turbine, thermal analysis on an Engine Manifold etc.

7. **Can we check the behavior of fine solid particles in a fluid flow?**

Yes, the Fluid Dynamics Engineer role has a Lagrangian Particle Track capability using which we can study the trajectories of fine solid particles carried inside a fluid flow.

We can simulate the effect of particles with mass or even massless particles. For particles with mass, the solver considers the different forces acting on the

particles due to the fluid like the buoyant, drag and pressure forces. For large particles, the effect of particle motion on the fluid flow field will also be considered in the analysis.

The thermal effect on the particles, i.e. the heating or cooling effect on the particles in the fluid flow, can also be simulated.

8. Can we run a Parametric Design Study on the 3DEXPERIENCE Platform?

Yes, we can run a parametric design study on the platform. This allows us to run multiple simulations in a single go, by defining Parameter Design Variables which would vary for every simulation as defined by the user.

We can basically run a Design Improvement Study, to improve a given design. This Design Improvement Study can be run on all the Simulation roles i.e. for Structural, CFD, Plastic Injection as well as Electromagnetic Analysis.

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